

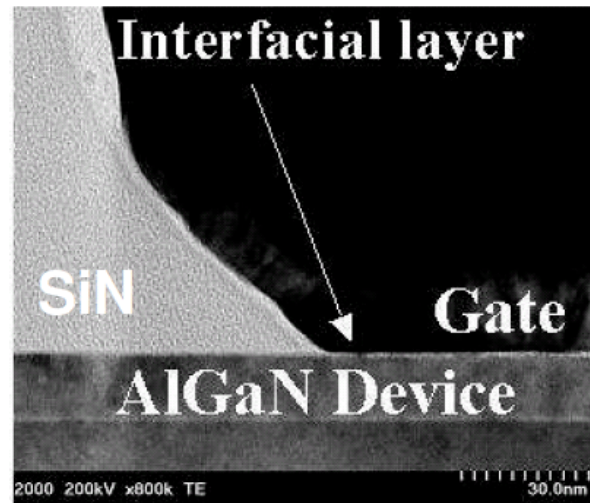
LEAP and TEM of GaN HEMTs

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Reliability issues with GaN devices

- Nitronex has reported that a very thin ($< 50\text{\AA}$) interfacial layer between the Gate and AlGaN negatively affects reliability.¹

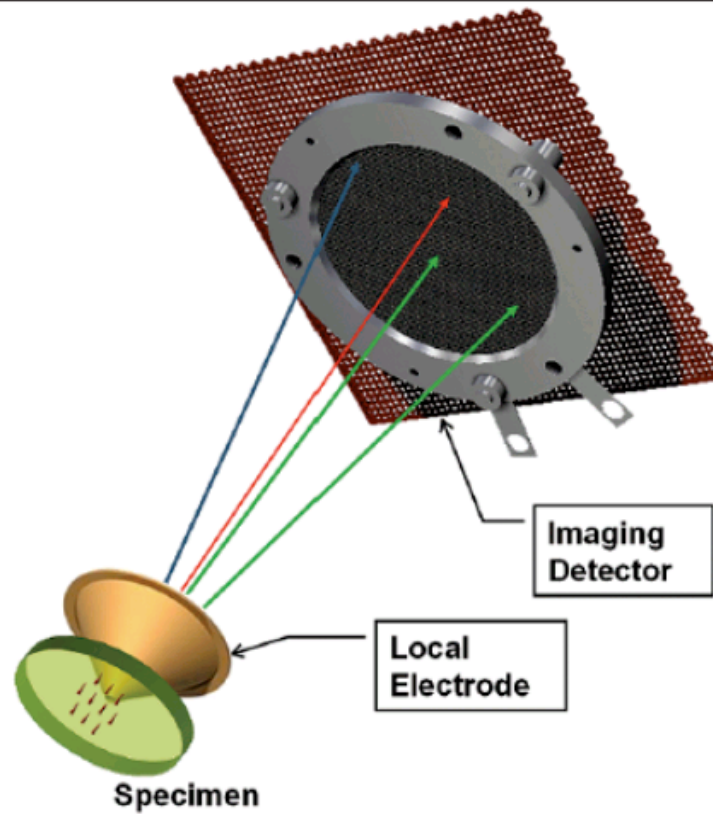


- Devices with a reduction of this layer show improved reliability.¹
- The composition of this layer and its origin are unknown.
- The layer is too thin to identify by TEM.
- New Approach: LEAP may be able to determine the atomic composition of this layer leading to methods to more effectively control its formation and width.

¹S. Singhal, T. Li, A. Chaudhuri, A.W. Hanson, R. Therrien, J.W. Johnson, W. Nagy, J. Marquart, P. Rajagopal, J.C. Roberts, E.L. Piner, I.C. Kizilyalli, and K.J. Linthicum. Microelectron. Reliab. **46**, 1247 (2006).

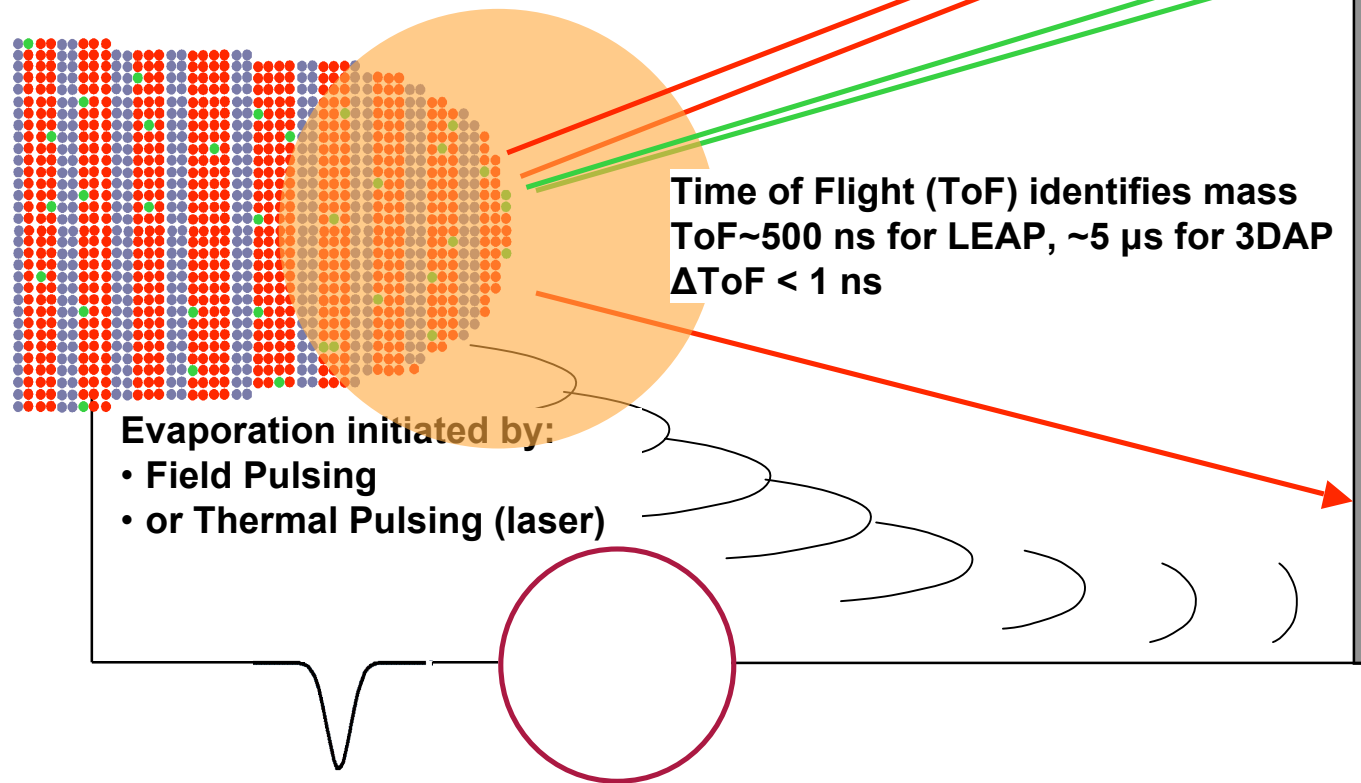
What is LEAP?

Local Electrode Atom Probe



Atom Probe Operation

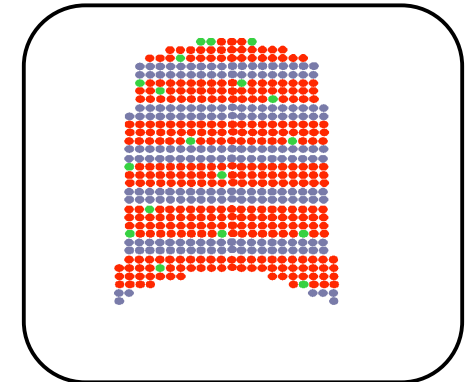
~50nm tip → 50mm detector = 10^6 magnification



2D Detector

Determines x,y coordinates of atom

Data are collected and interpreted

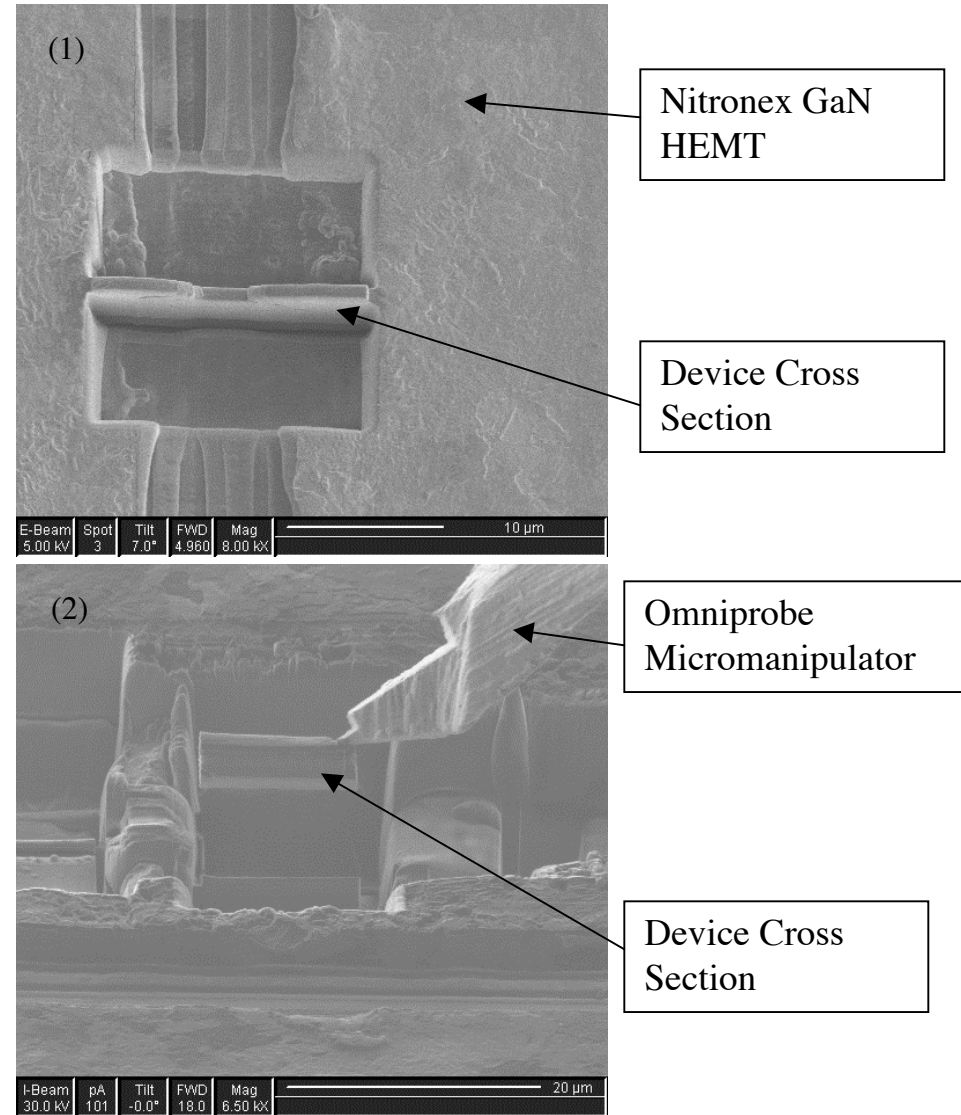


3-Dimensional Reconstructed Model of Specimen

z is determined from sequence of evaporation events

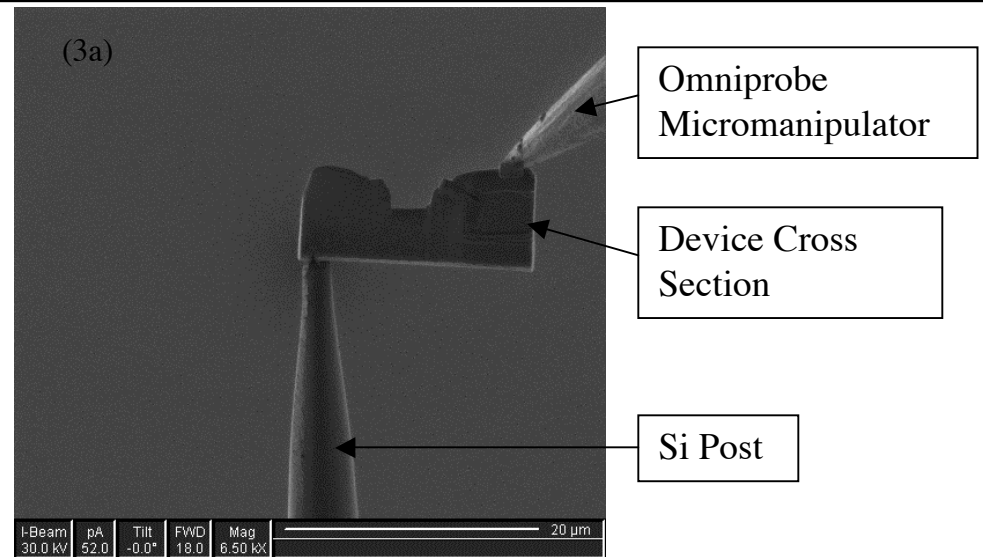
Constructing LEAP tips of GaN Devices

- 1) Procedure developed
- 2) FIB device cross section
 - 1) Sample lift out
 - 1) Mount on silicon post
 - 1) Sharpen tip

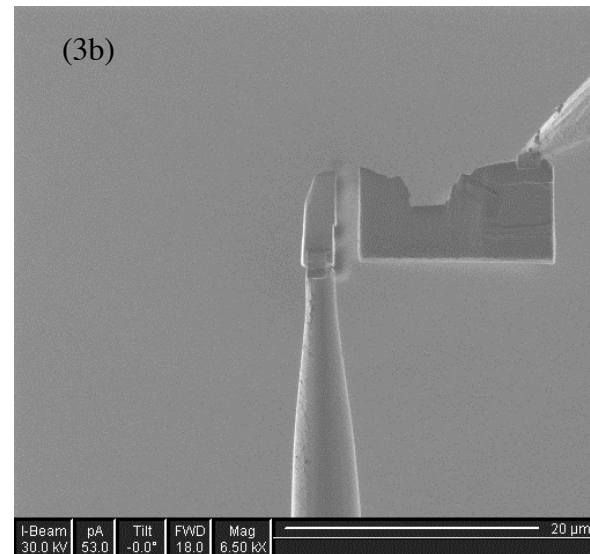


Constructing LEAP tips

- 1) FIB device cross section
- 2) Sample lift out
- 3) Mount on silicon post
 - a) Attach to post



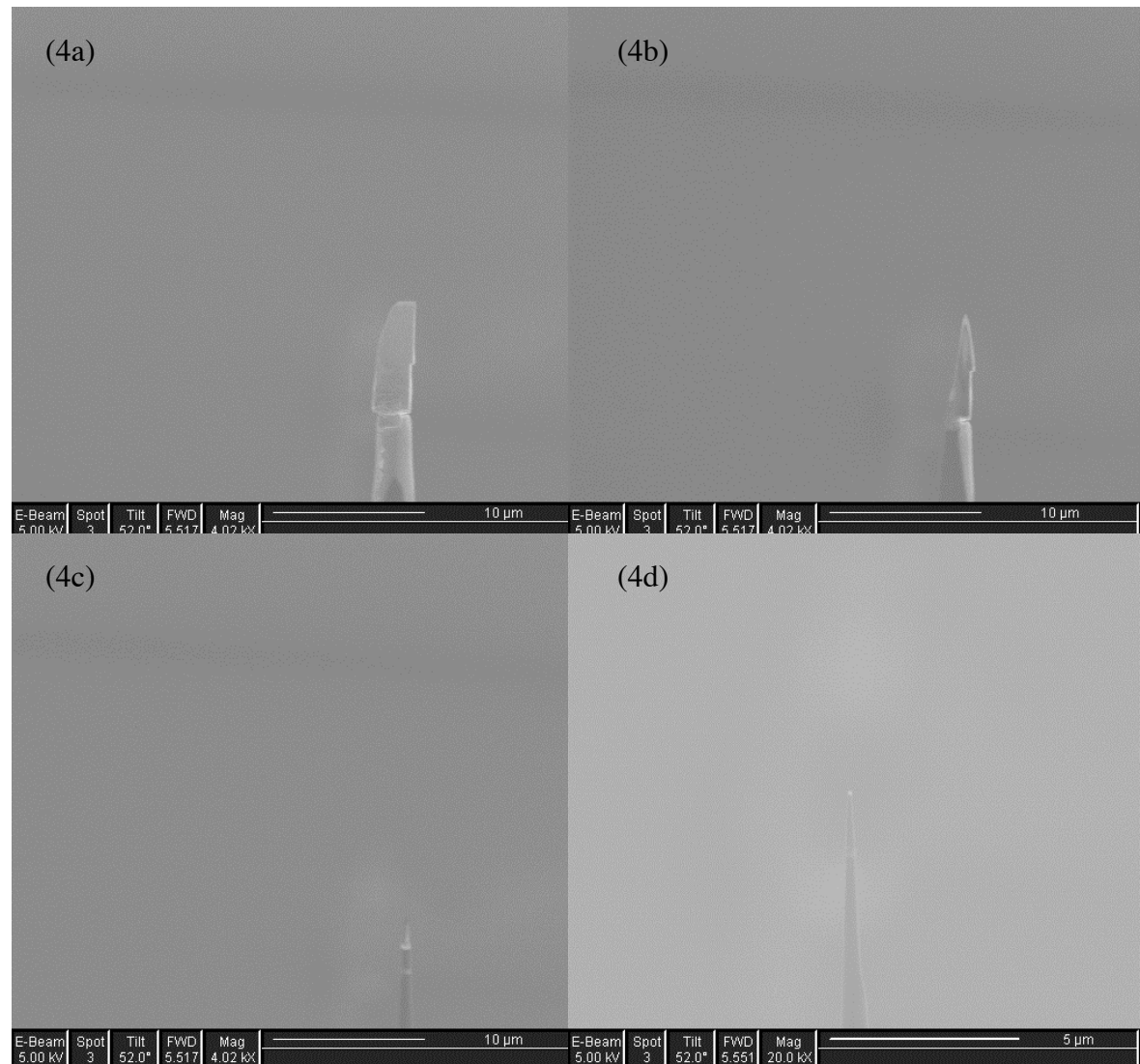
- b) Detach from cross section



- 4) Sharpen tip

Constructing LEAP tips

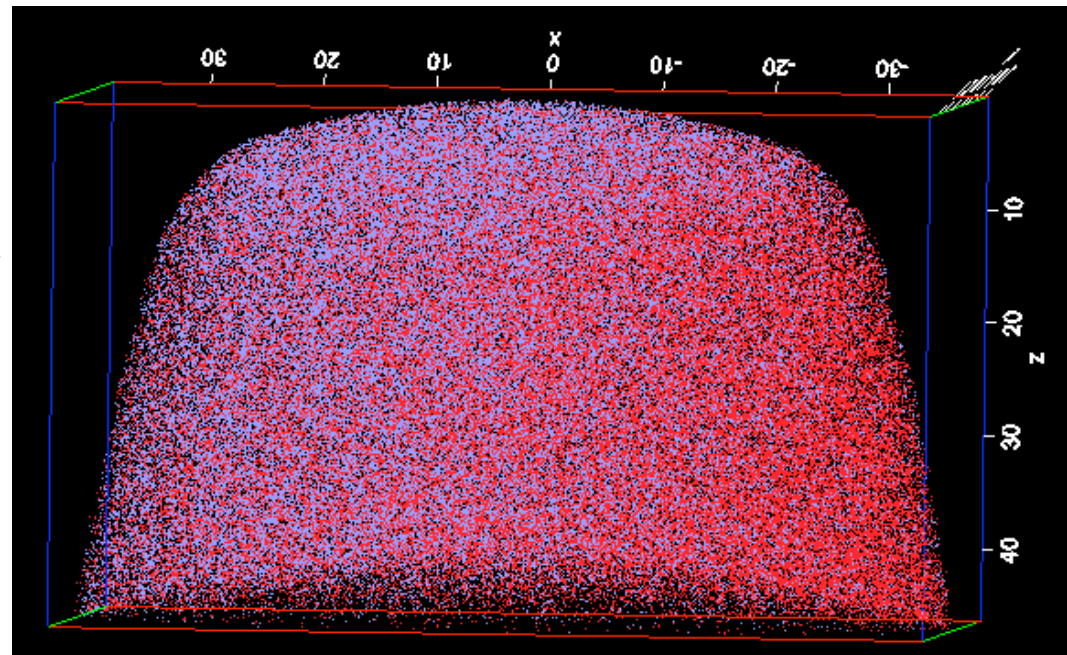
- 1) FIB device cross section
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Preliminary LEAP Analysis

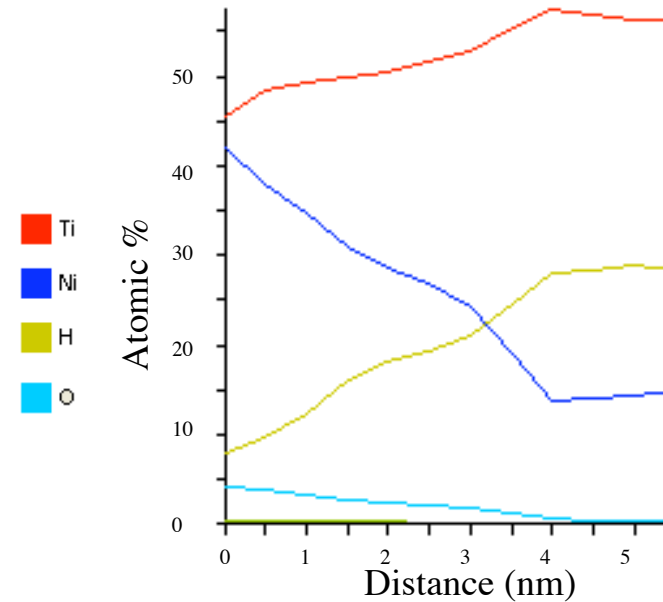
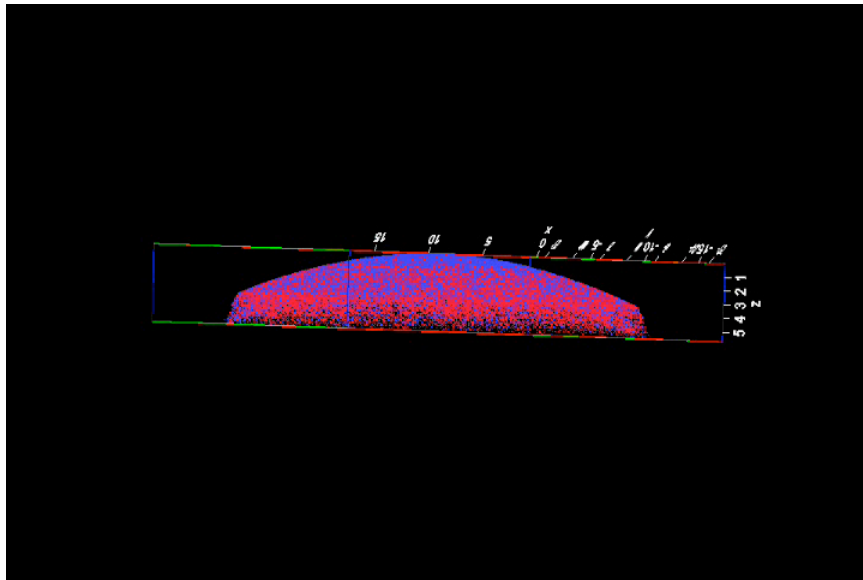
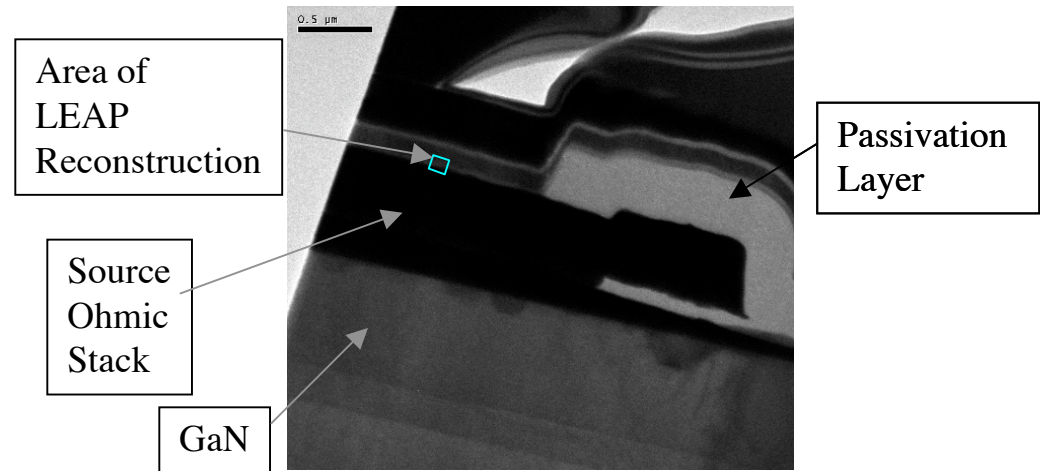
- First ever reported LEAP image from GaN
- Demonstrates that GaN can be analyzed by LEAP despite low conductivity
- 78,000,000 Atoms collected from this run
- Sample was run last week
- Data reconstruction and analysis still in progress
- LEAP reconstruction under gate

■ Ga
■ N



Preliminary LEAP Analysis

- LEAP reconstruction of part of the source ohmic contact stack
- Sample was run last week
- Data reconstruction and analysis still in progress



TEM Imaging

- Deprocessing procedure developed
- Site specific lift out procedure Developed for TEM
- Cross Sectional TEM imaging of devices in progress to further study structural changes

